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(54) AL ALLOY FIN MATERIAL EXCELLENT IN STRENGTH AFTER BRAZING AND BRAZABILITY

(57)Abstract:

PURPOSE: To provide an Al alloy fin material used for automobile heat exchanger, etc., produced by a brazing process and excellent in strength after brazing and brazability.

CONSTITUTION: This fin material is an alloy (a) having a chemical composition consisting of, by weight, 0.7-1.5% Si, 1.5-3% Mn, 0.01-0.25% V, 0.01-0.25% Zr, 0.01-0.25% Cr, and the balance Al with inevitable impurities and an alloy (b) having a chemical composition consisting of, by weight, 0.7-1.5% Si, 1.5-3% Mn, 0.01-0.25% V, 0.01-0.25% Zr, 0.01-0.25% Cr, further 0.2-1.5% Fe and/or 0.02-0.25% Ti, and the balance Al with inevitable impurities. Moreover, 0.05-0.3% Mg can be further incorporated into respective chemical compositions of the above alloys (a), (b). Further, at least one kind among 0.3-2% Zn, 0.02-0.2% Sn, and 0.005-0.05% In can be incorporated into all the chemical compositions mentioned above.

CLAIMS

[Claim(s)]

[Claim 1]At weight % , it is silicon (Si). : 0.7 to 1.5%, manganese (Mn) : 1.5 – 3 %, Vanadium (V) : 0.01 to 0.25%, and zirconium (Zr):0.01–0.25%, And chromium (Cr) : An aluminum alloy fin material excellent in after–soldering intensity and soldering nature which contain 0.01 to 0.25% and are characterized by the remainder having the chemical composition which consists of aluminum and an inevitable impurity.

[Claim 2]At weight % , it is silicon (Si). : 0.7 to 1.5%, manganese (Mn) : 1.5 – 3 %, Vanadium (V) : 0.01 to 0.25%, and zirconium (Zr):0.01–0.25%, And chromium (Cr) : Contain 0.01 to 0.25% and further, Iron (Fe) : 0.2 to 1.5%, and titanium (Ti) : An aluminum alloy fin material excellent in after–soldering intensity and soldering nature which contain at least one sort in 0.02 to 0.25% **, and are characterized by the remainder having the chemical composition which consists of aluminum and an inevitable impurity.

[Claim 3]At weight % , it is silicon (Si). : 0.7 to 1.5%, manganese (Mn) : 1.5 – 3 %, Vanadium (V) : 0.01 to 0.25%, and zirconium (Zr):0.01–0.25%, Chromium (Cr) : An aluminum alloy fin material excellent in after–soldering intensity and soldering nature which contain 0.01 to 0.25%, and magnesium (Mg):0.05–0.3%, and are characterized by the rema nder having the chemical composition which consists of aluminum and an inevitable impurity.

[Claim 4]At weight % , it is silicon (Si). : 0.7 to 1.5%, manganese (Mn) : 1.5 – 3 %, Vanadium (V) : 0.01 to 0.25%, and zirconium (Zr):0.01–0.25%, Chromium (Cr) : 0.01 to 0.25%, and magnesium (Mg):0.05–0.3%, It contains and is iron (Fe) further. : 0.2 to 1.5%, and titanium (Ti) : 0.02 to 0.25%, An aluminum alloy fin material excellent in after–soldering intensity and soldering nature which contain at least one sort in **, and are characterized by the remainder having the chemical composition which consists of aluminum and an inevitable impurity.

[Claim 5]At weight % , it is silicon (Si). : 0.7 to 1.5%, manganese (Mn) : 1.5 – 3 %, Vanadium (V) : 0.01 to 0.25%, and zirconium (Zr):0.01–0.25%, And chromium (Cr) : Contain 0.01 to 0.25% and further, Zinc (Zn) : 0.3 to 2%, tin (Sn) : 0.02 to 0.2%, And indium (In) : Inside of 0.005 to 0.05% **, and at least 1 An aluminum alloy fin material excellent in after–soldering intensity and soldering nature which contain a seed and are characterized by the remainder having the chemical composition which consists of aluminum and an inevitable impurity.

[Claim 6]At weight % , it is silicon (Si). : 0.7 to 1.5%, manganese (Mn) : 1.5 – 3 %,

Vanadium (V) : 0.01 to 0.25%, and zirconium (Zr):0.01-0.25%, And chromium (Cr) : Contain 0.01 to 0.25% and further, Iron (Fe) : 0.2 to 1.5%, and titanium (Ti) : 0.02 to 0.25%, The inside of **, and at least 1 A kind and zinc (Zn) : 0.3 to 2%, Tin (Sn) : 0.02 to 0.2%, and indium (In) : 0.005 to 0.05%, The inside of **, and at least 1 An aluminum alloy fin material excellent in after-soldering intensity and soldering nature which contain a seed and are characterized by the remainder having the chemical composition which consists of aluminum and an inevitable impurity.

[Claim 7]At weight % , it is silicon (Si). : 0.7 to 1.5%, manganese (Mn) : 1.5 - 3 %, Vanadium (V) : 0.01 to 0.25%, and zirconium (Zr):0.01-0.25%, Chromium (Cr) : 0.01 to 0.25%, and magnesium (Mg):0.05-0.3%, It contains and is zinc (Zn) further. : 0.3 to 2%, tin (Sn) : 0.02 to 0.2%, And indium (In) : Inside of 0.005 to 0.05% **, and at least 1 An aluminum alloy fin material excellent in after-soldering intensity and soldering nature which contain a seed and are characterized by the remainder having the chemical composition which consists of aluminum and an inevitable impurity.

[Claim 8]At weight % , it is silicon (Si). : 0.7 to 1.5%, manganese (Mn) : 1.5 - 3 %, Vanadium (V) : 0.01 to 0.25%, and zirconium (Zr):0.01-0.25%, Chromium (Cr) : 0.01 to 0.25%, and magnesium (Mg):0.05-0.3%, It contains and is iron (Fe) further. : 0.2 to 1.5%, and titanium (Ti) : 0.02 to 0.25%, The inside of **, and at least 1 A kind and zinc (Zn) : 0.3 to 2%, Tin (Sn) : 0.02 to 0.2%, and indium (In) : 0.005 to 0.05%, The inside of **, and at least 1 An aluminum alloy fin material excellent in after-soldering intensity and soldering nature which contain a seed and are characterized by the remainder having the chemical composition which consists of aluminum and an inevitable impurity.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention relates to the fin material used for the heat exchanger for cars etc. which are manufactured by a soldering construction method.

[0002]

[Description of the Prior Art]An aluminum alloy is light, excellent in thermal conductivity, and since corrosion resistance is good, it is widely used for manufacture of heat exchangers, such as a radiator of a car. The fin material of the **** aluminum alloy is assembled by soldering more nearly electrochemically [an aluminum alloy heat exchanger / the working-fluid passage material (henceforth a tubing material) which consists of an aluminum-Mn system alloy etc., for example] than this. And the corrosion prevention of the working-fluid passage material is electrochemically carried out by the sacrificial anode effect of the **** fin material.

[0003]Soldering is performed by heating the combination body of a tubing material and a fin material in a vacuum to soldering temperature, or heating it to it using flux in an inert atmosphere or the atmosphere. The brazing sheet which carried out the clad of the wax material, such as an aluminum-Si system or an aluminum-Si-Mg system, is used for either [at least] the tubing material or the fin material.

By the heating at high temperature at the time of soldering, intensity falls remarkably and a fin material changes it, or Si atom in wax material diffuses it in a fin material, and it is buckled.

Remarkable modification and buckling of such a fin material are generated by local melting of the material at the time of soldering heating (the character which does not produce such modification and buckling is hereafter called soldering nature).

[0004]The fin material for aluminum alloy heat exchangers needs sufficient intensity which does not change to the wind pressure at the time of the heat exchanger use after soldering, etc. It is important that the hot-working nature at the time of fin material manufacture is excellent.

[0005]Then, in order to improve the characteristic of the fin material of an aluminum alloy heat exchanger which was mentioned above, In order to raise the intensity after soldering into the aluminum-Mn system alloy containing about 1% of Mn, the following art in which the aluminum-Mn-Si system alloy which made about 1% of Si contain was made to contain further various elements is proposed. As art about the intensity after soldering of the fin material made from a heat exchanger aluminum alloy, and the

improvement of brazing nature, For example, JP,S58-156197,A (henceforth the advanced technology 1), JP,63-213646,A (henceforth the advanced technology 2), and JP,3-13550,A (henceforth the advanced technology 3) It is.

[0006]A3004 which uses the advanced technology 1 for a fin About an alloy, during soldering, In order that Si in aluminum- Si-alloy wax material may carry out fault diffusion inside a fin material and may carry out local fusion to it, the width of a soldering joint decreases remarkably, or, The intensity of a joint is prevented from falling and the aluminum alloy which made Cu contain 0.05 to 0.25% for the purpose of providing the plate fin type heat exchanger for ultra-high pressure is indicated.

[0007]Preventing the fall of a sacrificial anode effect to the tubing material by evaporation of Zn in a fin material, when the advanced technology 2 carries out vacuum soldering of a fin material and the tubing material, and high temperature strength (cernuous-proof) And in order to secure the intensity after soldering, The composite which carried out the clad of the hide material made from an aluminum alloy which contained Sn 0.03 to 0.15% to both sides of the core material made from an aluminum alloy is indicated.

[0008]. A fin is crushed, when the advanced technology 3 carries out the thinning of the fin material with elevated-temperature-proof buckling nature, and carrying out corrugated processing of the fin because of insufficient strength and attaching a tubing material. It aims at manufacture of the fin material which had the high intensity for preventing the so-called generating of ordinary temperature buckling, The last Cr, Zr, Ti, and V are made to contain, and the art of performing annealing before final cold rolling with the degree of low temperature from the usual annealing temperature (300-450 **) of less than 240-300 ** performed before cold rolling is indicated.

[0009]

[Problem(s) to be Solved by the Invention]However, although Si which each was made to contain in order to raise the intensity after soldering demonstrates the effect in the advanced technology 1-3, On the other hand, when a fin material is heated to soldering temperature depending on the condition depending on soldering conditions, the solidus temperature of material may fall in an operation of Si which is dissolving in a fin material, and local melting may be caused. Thus, in the advanced technology 1-3, there is a problem in brazing nature, and since especially a phenomenon such becomes remarkable when the board thickness of an aluminum alloy fin material is thin, it is in the state where the demand to the thinning of a fin material increasing recently cannot be met enough.

[0010]Therefore, the purpose of this invention is to provide the aluminum alloy fin

material excellent in after-soldering intensity and soldering nature which solves the problem mentioned above and is used for the heat exchanger for cars etc. which are manufactured by a soldering construction method.

[0011]

[Means for Solving the Problem]About an aluminum alloy fin material excellent in after-soldering intensity and soldering nature, this invention persons acquired the following knowledge, as a result of repeating research wholeheartedly. Namely, to Mn in an aluminum alloy of an aluminum-Mn-Si system. Since there is an operation which promotes that Si deposits as an aluminum-Mn-Si system sludge and the amount of dissolution of Si is controlled, There is an effect which prevents a fall of solidus temperature of an aluminum alloy by dissolution of Si, And since these 3 element will be incorporated into an aluminum-Mn-Si system sludge, Si content ratio in this sludge will increase and the amount of dissolution of Si will decrease if three elements of V, and Zr and Cr live together, a fall of solidus temperature of an aluminum alloy is controlled.

[0012]What this invention is made based on the above-mentioned knowledge, and is characterized by comprising the following in order to attain the purpose of this invention.

Content of Mn was made to increase.

Three of V, and Zr and Cr. The feature remarkable in fulfilling making an element live together simultaneously

An aluminum alloy fin material of the 1st invention is weight % , and Namely, Si:0.7 -1.5%, Mn: 1.5 to 3%, V : 0.01 to 0.25%, Zr:0.01-0.25%, and Cr: 0.01 to 0.25% is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0013]An aluminum alloy fin material of the 2nd invention is weight % , and Si:0.7 -1.5%, Mn: 1.5 -3%, V:0.01 to 0.25%, Zr : 0.01 to 0.25%, And Cr: Contain 0.01 to 0.25% and it is Fe:0.2 -1.5% and Ti:0.02-0.25% of inside, and at least 1 further. A seed is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0014]An aluminum alloy fin material of the 3rd invention is weight % , and Si:0.7 -1.5%, Mn: 1.5 -3%, V:0.01 to 0.25%, Zr:0.01-0.25%, Cr:0.01-0.25%, and Mg: 0.05 to 0.3% is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0015]An aluminum alloy fin material of the 4th invention is weight % , and Si:0.7 -1.5%, Mn: 1.5 -3%, V:0.01 to 0.25%, Zr : 0.01 to 0.25%, Cr: 0.01-0.25% and Mg : 0.05 to 0.3% is

contained, Fe:0.2 −1.5% and Ti: 0.02 to 0.25% of inside, and at least 1 A seed is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0016]An aluminum alloy fin material of the 5th invention is weight % , and Si:0.7 −1.5%, Mn: 1.5 −3%, V:0.01 to 0.25%, Zr : 0.01 to 0.25%, And Cr : Contain 0.01 to 0.25% and further Zn:0.3 −2%, Sn: 0.02−0.2% and In: 0.005 to 0.05% of inside, and at least 1 A seed is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0017]An aluminum alloy fin material of the 6th invention is weight % , and Si:0.7 −1.5%, Mn: 1.5 −3%, V:0.01 to 0.25%, Zr : 0.01 to 0.25%, And Cr : Contain 0.01 to 0.25% and further Fe:0.2 −1.5%, and Ti:0.02−0.25% of inside −− at least −− 1 kind −− and, Zn: 0.3 −2%, Sn:0.02−0.2%, and In: 0.005 to 0.05% of inside, and at least 1 A seed is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0018]An aluminum alloy fin material of the 7th invention is weight % , and Si:0.7 −1.5%, Mn: 1.5 −3%, V:0.01 to 0.25%, Zr : 0.01 to 0.25%, Cr: 0.01−0.25% and Mg : 0.05 to 0.3% is contained, Zn:0.3 −2%, Sn:0.02−0.2%, and In: 0.005 to 0.05% of inside, and at least 1 A seed is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0019]An aluminum alloy fin material of the 8th invention is weight % , and Si:0.7 −1.5%, Mn: 1.5 −3%, V:0.01 to 0.25%, Zr : 0.01 to 0.25%, Cr: 0.01−0.25% and Mg : 0.05 to 0.3% is contained, Fe:0.2 −1.5% and Ti : 0.02 to 0.25% of inside, It is 1 kind and Zn:0.3 −2%, Sn:0.02−0.2%, and In:0.005 −0.05% of inside, and at least 1 at least. A seed is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0020]

[Function]The Reason limited within limits which mentioned above the chemical composition of the aluminum alloy fin material of this invention is explained.

(1) Si:Si dissolves in an aluminum alloy, or deposits as an aluminum−Mn−Si system compound, and has the operation which raises the intensity after soldering. However, as for the effect, less than 0.7% is [the content] insufficient, and on the other hand, at more than 1.5%, the amount of dissolution becomes excessive, and solidus temperature turns into below soldering temperature, and causes local melting. Therefore, the content of Si should carry out 0.7 to 1.5% of within the limits.

[0021](2) The content of Mn:Mn is high as compared with conventional technology, and is the most characteristic element in this invention. Since Mn has the operation

which promotes that Si deposits as an aluminum-Mn-Si system compound and controls the amount of dissolution of Si, it prevents the fall of the solidus temperature of the aluminum alloy by dissolution of Si, and has the effect of preventing local melting. However, as for the effect, less than 1.5% is [the content] insufficient, and, on the other hand, hot-working nature falls by more than 3% at the hot-working process in a manufacturing process of an Al alloy sheet raw material. Therefore, the content of Mn should carry out 1.5 to 3% of within the limits.

[0022](3) V, Zr and Cr : in this invention, it is 3 of V, and Zr and Cr. It is characteristic to make it the chemical composition which made the element live together as compared with technical idea of conventional technology. Zr [V and] and these 3 element being incorporated into an aluminum-Mn-Si system sludge, and Cr, if these 3 element lives together, In order for Si content ratio in this sludge to increase, and for the amount of dissolution of Si to decrease and to promote a deposit of an aluminum-Mn-Si system sludge, it has the operation which controls the fall of the solidus temperature of an aluminum alloy, and has an effect which controls local melting. however, the following of said effect is [each content of V, Zr, and Cr] insufficient 0.01%, on the other hand, each content of V, and Zr and Cr is a hot-working process in a manufacturing process of an Al alloy sheet raw material in ** 0.25%, and hot-working nature falls. Therefore, each content of V, and Zr and Cr should carry out 0.01 to 0.25% of within the limits.

[0023](4) Fe, Ti:Fe, and Ti have the operation which carries out minuteness making of the aluminum-Mn-Si system sludge, and have the effect of raising the intensity after soldering. however, the following of the effect is [the content of Fe / the content of less than 0.2% and Ti] insufficient 0.02%, on the other hand, the content of more than 1.5% and Ti of the content of Fe is a hot-working process in a manufacturing process of an Al alloy sheet raw material in ** 0.25%, and hot-working nature falls. Therefore, the content of Fe should carry out content of Ti 0.02 to 0.25% of within the limits 0.2 to 1.5%.

[0024](5) Mg:Mg has the effect of raising the intensity after soldering. However, the following of the effect of the improving strength after soldering is [the content] insufficient 0.05%, on the other hand, at more than 0.3%, solidus temperature turns into below soldering temperature, and local melting is caused. Therefore, the content of Mg should carry out 0.05 to 0.3% of within the limits.

[0025](6) Each of Zn, Sn and In:Zn, Sn, and In(s) has the operation which makes electrochemical potential of an aluminum alloy **, and gives a sacrificial anode effect. However. as for the content of Zn, the content of In the content of Sn 0.02% less than

0.3% in less than 0.005%. [the following] the effect is insufficient, as for the content of more than 2% and Sn, on the other hand, 0.05%, by **, electrochemical potential becomes ** too much and, as for the content of Zn, a self-corrosion rate becomes large too much, as for the content of more than 0.2% and In. Therefore, as for the content of Zn, the content of Sn should make content of In 0.005 to 0.05% of within the limits 0.02 to 0.2% 0.3 to 2%.

[0026]

[Example]Next, this invention is explained according to working example, contrasting with a comparative example. Table 1 No.I-1 which has the chemical composition of this invention shown in 2 within the limits - 43 -- and, [and] Table 3 And prepare the aluminum alloy molten metal of No.C-1 which has the chemical composition besides the range of this invention shown in 4 - 25, from this, cast the slab of a size (width 200 mm, length 400 mm, and 50 mm in thickness), and rank second, After homogenizing in slab, with hot-rolling, it was considered as the 5-mm-thick hot-rolling board, and further, intermediate annealing and cold rolling were repeated and performed, it was considered as the cold-rolled board of thickness 0.1 mm, and the aluminum alloy fin material was manufactured.

[0027]

[Table 1]

	No	化学成分組成 (wt.%)										
		Si	Mn	V	Zr	Cr	Mg	Fe	Ti	Zn	Sn	In
本発明Al合金フィン材	I-1	0.96	1.51	0.13	0.10	0.14	—	—	—	—	—	—
	I-2	1.02	1.81	0.11	0.11	0.13	—	—	—	—	—	—
	I-3	1.13	2.34	0.12	0.13	0.12	—	—	—	—	—	—
	I-4	1.03	2.91	0.11	0.11	0.13	—	—	—	—	—	—
	I-5	0.75	2.35	0.14	0.11	0.13	—	—	—	—	—	—
	I-6	1.49	2.28	0.12	0.12	0.13	—	—	—	—	—	—
	I-7	1.33	2.31	0.02	0.11	0.13	—	—	—	—	—	—
	I-8	1.31	2.25	0.24	0.13	0.12	—	—	—	—	—	—
	I-9	1.14	2.28	0.13	0.02	0.13	—	—	—	—	—	—
	I-10	1.12	2.33	0.11	0.25	0.12	—	—	—	—	—	—
	I-11	1.12	2.36	0.12	0.13	0.03	—	—	—	—	—	—
	I-12	0.81	2.04	0.13	0.13	0.25	—	—	—	—	—	—
	I-13	1.12	2.31	0.10	0.11	0.15	—	0.32	—	—	—	—
	I-14	1.18	2.39	0.11	0.14	0.14	—	0.81	—	—	—	—
	I-15	1.15	2.27	0.13	0.13	0.14	—	1.50	—	—	—	—
	I-16	1.39	2.25	0.14	0.13	0.13	—	—	0.02	—	—	—
	I-17	1.24	2.31	0.16	0.15	0.13	—	—	0.13	—	—	—
	I-18	0.88	2.23	0.15	0.14	0.15	—	—	0.24	—	—	—
	I-19	1.12	2.30	0.15	0.11	0.14	—	0.22	0.24	—	—	—
	I-20	1.26	2.15	0.13	0.13	0.14	—	0.81	0.10	—	—	—
	I-21	1.22	2.20	0.12	0.15	0.15	—	1.44	0.03	—	—	—

[0028]

[Table 2]

	No	化学成分組成 (wt.%)										
		Si	Mn	V	Zr	Cr	Mg	Fe	Ti	Zn	Sn	In
本発明Al合金フィン材	I-22	1.23	2.26	0.16	0.14	0.13	0.05	—	—	—	—	—
	I-23	1.16	2.20	0.13	0.13	0.15	0.28	—	—	—	—	—
	I-24	1.18	2.25	0.14	0.12	0.14	0.05	0.83	—	—	—	—
	I-25	1.21	2.23	0.15	0.14	0.16	0.28	—	0.13	—	—	—
	I-26	1.19	2.26	0.14	0.15	0.15	0.05	0.83	0.15	—	—	—
	I-27	1.24	2.18	0.14	0.13	0.13	0.30	0.79	0.13	—	—	—
	I-28	1.21	2.22	0.14	0.15	0.14	—	—	—	1.24	—	—
	I-29	1.22	2.21	0.15	0.13	0.14	—	—	—	—	0.10	—
	I-30	1.22	2.23	0.13	0.14	0.15	—	—	—	—	—	0.025
	I-31	1.26	2.06	0.12	0.14	0.15	—	—	—	1.89	0.19	0.047
	I-32	1.22	2.20	0.13	0.16	0.13	—	0.80	—	1.28	—	—
	I-33	1.25	2.24	0.15	0.14	0.13	—	—	0.15	—	0.12	—
	I-34	1.21	2.20	0.14	0.14	0.15	—	0.55	0.13	—	—	0.023
	I-35	1.21	2.13	0.13	0.12	0.15	—	0.22	0.14	1.99	0.20	0.049
	I-36	1.19	2.15	0.15	0.13	0.15	0.20	—	—	1.26	—	—
	I-37	1.21	2.23	0.13	0.15	0.16	0.19	—	—	—	0.14	—
	I-38	1.24	2.20	0.14	0.12	0.13	0.23	—	—	—	—	0.025
	I-39	1.18	2.19	0.15	0.14	0.14	0.21	—	—	1.86	0.19	0.045
	I-40	1.18	2.22	0.13	0.16	0.13	0.20	0.81	0.14	1.23	—	—
	I-41	1.23	2.19	0.15	0.13	0.14	0.21	0.78	0.15	—	0.15	—
	I-42	1.21	2.23	0.14	0.14	0.16	0.19	0.81	0.12	—	—	0.022
	I-43	1.46	2.94	0.20	0.23	0.22	0.28	1.48	0.24	1.93	0.20	0.042

[0029]

[Table 3]

	No	化学成分組成 (wt.%)											
		Si	Mn	V	Zr	Cr	Mg	Fe	Ti	Zn	Sn	In	Cu
比較Al合金フィン材	C-1	0.95	1.41	0.14	0.10	0.12	—	—	—	—	—	—	—
	C-2	1.01	3.14	0.11	0.13	0.10	—	—	—	—	—	—	—
	C-3	0.63	2.30	0.13	0.10	0.15	—	—	—	—	—	—	—
	C-4	1.64	2.19	0.13	0.12	0.16	—	—	—	—	—	—	—
	C-5	1.28	2.33	0.006	0.11	0.13	—	—	—	—	—	—	—
	C-6	1.17	2.15	0.27	0.13	0.15	—	—	—	—	—	—	—
	C-7	1.13	2.36	0.13	0.007	0.14	—	—	—	—	—	—	—
	C-8	1.12	2.38	0.12	0.26	0.11	—	—	—	—	—	—	—
	C-9	1.18	2.41	0.10	0.13	0.006	—	—	—	—	—	—	—
	C-10	0.82	2.01	0.09	0.15	0.27	—	—	—	—	—	—	—
	C-11	1.14	2.27	0.14	0.11	0.10	—	1.63	—	—	—	—	—
	C-12	0.90	2.18	0.11	0.10	0.11	—	—	0.27	—	—	—	—
	C-13	1.28	1.98	0.13	0.12	0.12	—	0.90	0.28	—	—	—	—
	C-14	1.16	2.20	0.13	0.13	0.15	0.42	—	—	—	—	—	—

[0030]

[Table 4]

	No	化学成分組成 (wt.%)											
		Si	Mn	V	Zr	Cr	Mg	Fe	Ti	Zn	Sn	In	Cu
比	C-15	1.24	2.18	0.14	0.13	0.13	0.38	0.79	0.13	—	—	—	—
較	C-16	1.13	2.34	0.12	0.13	0.12	—	—	—	2.56	—	—	—
Al	C-17	1.13	2.34	0.12	0.13	0.12	—	—	—	—	0.32	—	—
合	C-18	1.13	2.34	0.12	0.13	0.12	—	—	—	—		0.062	—
金	C-19	1.13	2.34	0.12	0.13	0.12	—	—	—	—	0.32	0.061	—
フ	C-20	1.13	2.34	0.12	0.13	0.12	—	—	—	2.30	0.35	0.059	—
ィ	C-21	1.23	2.13	0.15	0.15	0.13	—	0.83	0.11	2.31	0.33	0.063	—
ン	C-22	1.25	2.20	0.14	0.16	0.14	0.14	—	—	2.28	0.31	0.061	—
材	C-23	1.24	2.18	0.14	0.13	0.13	0.30	0.79	0.13	2.25	0.34	0.056	—
従	C-24	0.88	0.85	—	<0.01	<0.01	0.70	0.25	0.01	—	—	—	0.23
来	C-25	0.63	1.35	—	0.72	0.08	0.53	0.40	0.06	—	—	—	0.21

(注) 従来:: 従来Al合金フィン材を意味する。

[0031]In order to evaluate the hot-working nature in the manufacturing process of an Al alloy sheet raw material, the existence of the crack generation of the surface of said hot-rolling board was inspected visually.

[0032]The aluminum alloy fin material blank test material of said thickness 0.1 mm is extracted, The vacuum-chamber internal pressure of 0.1 Pa which is the conditions equivalent to vacuum soldering, and temperature 605 **5 After performing processing cooled after maintenance between parts, the predetermined specimen was prepared and a tensile test, measurement of solidus temperature, and measurement of pitting generating potential were presented. The Shimadzu DTA-50 type testing machine was used for measurement of solidus temperature. The measurement result of the various above-mentioned examinations was shown in Table 5, and 6 and 7.

[0033]

[Table 5]

	No	引張強さ (N/mm²)	固相線温度 (℃)	孔食発生電位 (V vs.SCE)	熱延時のクラック発生有無
本発明Al合金フィン材	I-1	191	642	−0.77	無し
	I-2	193	644	−0.77	無し
	I-3	194	650	−0.77	無し
	I-4	196	654	−0.77	無し
	I-5	190	655	−0.77	無し
	I-6	215	646	−0.77	無し
	I-7	194	638	−0.77	無し
	I-8	196	653	−0.77	無し
	I-9	194	638	−0.77	無し
	I-10	196	653	−0.77	無し
	I-11	194	638	−0.77	無し
	I-12	196	653	−0.77	無し
	I-13	205	650	−0.77	無し
	I-14	216	651	−0.77	無し
	I-15	227	651	−0.77	無し
	I-16	201	650	−0.77	無し
	I-17	208	650	−0.77	無し
	I-18	215	651	−0.77	無し
	I-19	220	650	−0.77	無し
	I-20	221	651	−0.77	無し
	I-21	220	651	−0.77	無し

[0034]

[Table 6]

	No	引張強さ (N/mm²)	固相線温度 (℃)	孔食発生電位 (V vs.SCE)	熱延時のクラック発生有無
本発明Al合金フィン材	I-22	206	646	−0.77	無し
	I-23	225	640	−0.77	無し
	I-24	226	647	−0.77	無し
	I-25	236	639	−0.77	無し
	I-26	237	647	−0.77	無し
	I-27	242	638	−0.77	無し
	I-28	194	649	−0.92	無し
	I-29	194	650	−0.93	無し
	I-30	194	650	−0.93	無し
	I-31	194	649	−0.97	無し
	I-32	217	649	−0.93	無し
	I-33	209	649	−0.94	無し
	I-34	215	650	−0.93	無し
	I-35	216	650	−0.98	無し
	I-36	215	642	−0.92	無し
	I-37	214	643	−0.93	無し
	I-38	218	642	−0.92	無し
	I-39	217	641	−0.96	無し
	I-40	243	642	−0.91	無し
	I-41	242	644	−0.93	無し
	I-42	245	643	−0.91	無し
	I-43	251	642	−0.97	無し

[0035]

[Table 7]

	No	引張強さ (N/mm²)	固相線温度 (℃)	孔食発生電位 (V vs.SCE)	熱延時のクラック発生有無
比較Al合金フィン材	C-1	190	615*	−0.77	無し
	C-2	198	657	−0.77	有り*
	C-3	164*	656	−0.77	無し
	C-4	219	614*	−0.77	無し
	C-5	194	617*	−0.77	無し
	C-6	196	654	−0.77	有り*
	C-7	194	617*	−0.77	無し
	C-8	196	654	−0.77	有り*
	C-9	194	617*	−0.77	無し
	C-10	196	654	−0.77	有り*
	C-11	230	651	−0.77	有り*
	C-12	217	651	−0.77	有り*
	C-13	226	651	−0.77	有り*
	C-14	228	617*	−0.77	無し
	C-15	245	618*	−0.77	無し
	C-16	194	649	−1.22*	無し
	C-17	194	650	−1.29*	無し
	C-18	194	650	−1.27*	無し
	C-19	194	650	−1.39*	無し
	C-20	194	650	−1.44*	無し
	C-21	238	649	−1.45*	無し
	C-22	221	649	−1.45*	無し
	C-23	242	649	−1.45*	無し
従来	C-24	244	606*	−0.74	無し
	C-25	211	612*	−0.74	有り*

(注) 従来は、従来Al合金フィン材を意味する。また、*印をつけたものは、特性値が劣るものである。

[0036]Table 1 The following matter is clear from −7.

** Although the thing of insufficient strength occurred like the No. C−3 in the comparison aluminum alloy fin material about tensile strength, even if there is nothing of such insufficient strength in this invention aluminum alloy fin material and it compared with the aluminum alloy fin material conventionally, the equivalent outstanding intensity was obtained.

[0037]** About solidus temperature, No.C−1 of a comparison aluminum alloy fin material, 4, 5, 7, 9 and 14, and 15 were 614 − 618 **, and were low, it was low conventionally to the same extent as an aluminum alloy fin material, and improvement in soldering nature was not carried out. On the other hand, each this invention aluminum alloy fin material is 638−655 ** and high temperature, and its soldering nature improved remarkably.

[0038]** No.C−16 of a comparison aluminum alloy fin material − 23 are −1.45 −

$-1.22V_{vs}$S C E to being potential with -1.10 - $-0.60V_{vs}$S C E desirable about pitting generating potential.
Electrochemical potential becomes ** too much in each case, and the self-corrosion rate became large too much.
On the other hand, all the pitting corrosion potential of this invention aluminum alloy fin material is -0.98 - $-0.77V_{vs}$S C E, and the desirable sacrificial anode effect was acquired.
** Although it generated in No.C-2 of a comparison aluminum alloy fin material, 6 and 8, and 10-13 about the crack at the time of hot-rolling, it did not generate in this invention aluminum alloy fin material.
[0039]As mentioned above, this invention aluminum alloy fin material improves about soldering nature conventionally more remarkably than an aluminum alloy fin material and a comparison aluminum alloy fin material, and is excellent conventionally to the same extent as an aluminum alloy fin material about the intensity after soldering. About a sacrificial anode effect, it is equivalent to a former and comparison aluminum alloy fin material, and, moreover, excelled a former and comparison aluminum alloy fin material and more than equivalent also about the hot-working nature of the aluminum alloy in the manufacturing process of a fin material.

[0040]
[Effect of the Invention]As stated above, according to the aluminum alloy fin material of this invention, local melting is not caused at the time of soldering heating, A useful effect is brought about on the industry which the aluminum alloy fin material which generating of with poor soldering was lost, and was excellent in soldering nature, and was excellent on a par with an alloy fin material conventionally also about the intensity after soldering is obtained, and can meet enough the demand to the thinning of an aluminum alloy fin material.

[Translation done.]

TECHNICAL FIELD

[Industrial Application]This invention relates to the fin material used for the heat exchanger for cars etc. which are manufactured by a soldering construction method.

[Translation done.]

PRIOR ART

[Description of the Prior Art]An aluminum alloy is light, excellent in thermal conductivity, and since corrosion resistance is good, it is widely used for manufacture of heat exchangers, such as a radiator of a car. The fin material of the **** aluminum alloy is assembled by soldering more nearly electrochemically [an aluminum alloy heat exchanger / the working-fluid passage material (henceforth a tubing material) which consists of an aluminum-Mn system alloy etc., for example] than this. And the corrosion prevention of the working-fluid passage material is electrochemically carried out by the sacrificial anode effect of the **** fin material.

[0003]Soldering is performed by heating the combination body of a tubing material and a fin material in a vacuum to soldering temperature, or heating it to it using flux in an inert atmosphere or the atmosphere. The brazing sheet which carried out the clad of the wax material, such as an aluminum-Si system or an aluminum-Si-Mg system, is used for either [at least] the tubing material or the fin material.

By the heating at high temperature at the time of soldering, intensity falls remarkably and a fin material changes it, or Si atom in wax material diffuses it in a fin material, and it is buckled.

Remarkable modification and buckling of such a fin material are generated by local melting of the material at the time of soldering heating (the character which does not produce such modification and buckling is hereafter called soldering nature).

[0004]The fin material for aluminum alloy heat exchangers needs sufficient intensity which does not change to the wind pressure at the time of the heat exchanger use after soldering, etc. It is important that the hot-working nature at the time of fin material manufacture is excellent.

[0005]Then, in order to improve the characteristic of the fin material of an aluminum alloy heat exchanger which was mentioned above, In order to raise the intensity after soldering into the aluminum-Mn system alloy containing about 1% of Mn, the following art in which the aluminum-Mn-Si system alloy which made about 1% of Si contain was made to contain further various elements is proposed. As art about the intensity after soldering of the fin material made from a heat exchanger aluminum alloy, and the improvement of brazing nature, For example, JP,S58-156197,A (henceforth the advanced technology 1), JP,63-213646,A (henceforth the advanced technology 2), and JP,3-13550,A (henceforth the advanced technology 3) It is.

[0006]A3004 which uses the advanced technology 1 for a fin About an alloy, during soldering, In order that Si in aluminum- Si-alloy wax material may carry out fault

diffusion inside a fin material and may carry out local fusion to it, the width of a soldering joint decreases remarkably, or, The intensity of a joint is prevented from falling and the aluminum alloy which made Cu contain 0.05 to 0.25% for the purpose of providing the plate fin type heat exchanger for ultra-high pressure is indicated.
[0007]Preventing the fall of a sacrificial anode effect to the tubing material by evaporation of Zn in a fin material, when the advanced technology 2 carries out vacuum soldering of a fin material and the tubing material, and high temperature strength (cernuous-proof) And in order to secure the intensity after soldering, The composite which carried out the clad of the hide material made from an aluminum alloy which contained Sn 0.03 to 0.15% to both sides of the core material made from an aluminum alloy is indicated.
[0008]. A fin is crushed, when the advanced technology 3 carries out the thinning of the fin material with elevated-temperature-proof buckling nature, and carrying out corrugated processing of the fin because of insufficient strength and attaching a tubing material. It aims at manufacture of the fin material which had the high intensity for preventing the so-called generating of ordinary temperature buckling, The last Cr, Zr, Ti, and V are made to contain, and the art of performing annealing before final cold rolling with the degree of low temperature from the usual annealing temperature (300-450 **) of less than 240-300 ** performed before cold rolling is indicated.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]As stated above, according to the aluminum alloy fin material of this invention, local melting is not caused at the time of soldering heating, A useful effect is brought about on the industry which the aluminum alloy fin material which generating of with poor soldering was lost, and was excellent in soldering nature, and was excellent on a par with an alloy fin material conventionally also about the intensity after soldering is obtained, and can meet enough the demand to the thinning of an aluminum alloy fin material.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, although Si which each was made to contain in order to raise the intensity after soldering demonstrates the effect in the advanced technology 1-3, On the other hand, when a fin material is heated to soldering temperature depending on the condition depending on soldering conditions, the solidus temperature of material may fall in an operation of Si which is dissolving in a fin material, and local melting may be caused. Thus, in the advanced technology 1-3, there is a problem in brazing nature, and since especially a phenomenon such becomes remarkable when the board thickness of an aluminum alloy fin material is thin, it is in the state where the demand to the thinning of a fin material increasing recently cannot be met enough.

[0010]Therefore, the purpose of this invention is to provide the aluminum alloy fin material excellent in after-soldering intensity and soldering nature which solves the problem mentioned above and is used for the heat exchanger for cars etc. which are manufactured by a soldering construction method.

[Translation done.]

MEANS

[Means for Solving the Problem]About an aluminum alloy fin material excellent in after-soldering intensity and soldering nature, this invention persons acquired the following knowledge, as a result of repeating research wholeheartedly. Namely, to Mn in an aluminum alloy of an aluminum-Mn-Si system. Since there is an operation which promotes that Si deposits as an aluminum-Mn-Si system sludge and the amount of dissolution of Si is controlled, There is an effect which prevents a fall of solidus temperature of an aluminum alloy by dissolution of Si, And since these 3 element will be incorporated into an aluminum-Mn-Si system sludge, Si content ratio in this sludge will increase and the amount of dissolution of Si will decrease if three elements of V, and Zr and Cr live together, a fall of solidus temperature of an aluminum alloy is controlled.

[0012]What this invention is made based on the above-mentioned knowledge, and is characterized by comprising the following in order to attain the purpose of this invention.

Content of Mn was made to increase.

Three of V, and Zr and Cr. The feature remarkable in fulfilling making an element live together simultaneously

An aluminum alloy fin material of the 1st invention is weight % , and Namely, Si:0.7 -1.5%, Mn: 1.5 to 3%, V : 0.01 to 0.25%, Zr:0.01-0.25%, and Cr: 0.01 to 0.25% is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0013]An aluminum alloy fin material of the 2nd invention is weight % , and Si:0.7 -1.5%, Mn: 1.5 -3%, V:0.01 to 0.25%, Zr : 0.01 to 0.25%, And Cr: Contain 0.01 to 0.25% and it is Fe:0.2 -1.5% and Ti:0.02-0.25% of inside, and at least 1 further. A seed is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0014]An aluminum alloy fin material of the 3rd invention is weight % , and Si:0.7 -1.5%, Mn: 1.5 -3%, V:0.01 to 0.25%, Zr:0.01-0.25%, Cr:0.01-0.25%, and Mg: 0.05 to 0.3% is containec and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0015]An aluminum alloy fin material of the 4th invention is weight % , and Si:0.7 -1.5%, Mn: 1.5 -3%, V:0.01 to 0.25%, Zr : 0.01 to 0.25%, Cr: 0.01-0.25% and Mg : 0.05 to 0.3% is contained, Fe:0.2 -1.5% and Ti: 0.02 to 0.25% of inside, and at least 1 A seed is contained and the remainder has the feature to have the chemical composition which

consists of aluminum and an inevitable impurity.

[0016]An aluminum alloy fin material of the 5th invention is weight % , and Si:0.7 −1.5%, Mn: 1.5 −3%, V:0.01 to 0.25%, Zr : 0.01 to 0.25%, And Cr : Contain 0.01 to 0.25% and further Zn:0.3 −2%, Sn: 0.02−0.2% and In: 0.005 to 0.05% of inside, and at least 1 A seed is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0017]An aluminum alloy fin material of the 6th invention is weight % , and Si:0.7 −1.5%, Mn: 1.5 −3%, V:0.01 to 0.25%, Zr : 0.01 to 0.25%, And Cr : Contain 0.01 to 0.25% and further Fe:0.2 −1.5%, and Ti:0.02−0.25% of inside −− at least −− 1 kind −− and, Zn: 0.3 −2%, Sn:0.02−0.2%, and In: 0.005 to 0.05% of inside, and at least 1 A seed is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0018]An aluminum alloy fin material of the 7th invention is weight % , and Si:0.7 −1.5%, Mn: 1.5 −3%, V:0.01 to 0.25%, Zr : 0.01 to 0.25%, Cr: 0.01−0.25% and Mg : 0.05 to 0.3% is contained, Zn:0.3 −2%, Sn:0.02−0.2%, and In: 0.005 to 0.05% of inside, and at least 1 A seed is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[0019]An aluminum alloy fin material of the 8th invention is weight % , and Si:0.7 −1.5%, Mn: 1.5 −3%, V:0.01 to 0.25%, Zr : 0.01 to 0.25%, Cr: 0.01−0.25% and Mg : 0.05 to 0.3% is contained, Fe:0.2 −1.5% and Ti : 0.02 to 0.25% of inside, It is 1 kind and Zn:0.3 −2%, Sn:0.02−0.2%, and In:0.005 −0.05% of inside, and at least 1 at least. A seed is contained and the remainder has the feature to have the chemical composition which consists of aluminum and an inevitable impurity.

[Translation done.]

OPERATION

[Function]The Reason limited within limits which mentioned above the chemical composit on of the aluminum alloy fin material of this invention is explained.
(1) Si:Si dissolves in an aluminum alloy, or deposits as an aluminum-Mn-Si system compound, and has the operation which raises the intensity after soldering. However, as for the effect, less than 0.7% is [the content] insufficient, and on the other hand, at more than 1.5%, the amount of dissolution becomes excessive, and solidus temperature turns into below soldering temperature, and causes local melting. Therefore, the content of Si should carry out 0.7 to 1.5% of within the limits.
[0021](2) The content of Mn:Mn is high as compared with conventional technology, and is the most characteristic element in this invention. Since Mn has the operation which promotes that Si deposits as an aluminum-Mn-Si system compound and controls the amount of dissolution of Si, it prevents the fall of the solidus temperature of the aluminum alloy by dissolution of Si, and has the effect of preventing local melting. However, as for the effect, less than 1.5% is [the content] insufficient, and, on the other hand, hot-working nature falls by more than 3% at the hot-working process in a manufacturing process of an Al alloy sheet raw material. Therefore, the content of Mn should carry out 1.5 to 3% of within the limits.
[0022](3) V, Zr and Cr : in this invention, it is 3 of V, and Zr and Cr. It is characteristic to make it the chemical composition which made the element live together as compared with technical idea of conventional technology. Zr [V and] and these 3 element being incorporated into an aluminum-Mn-Si system sludge, and Cr, if these 3 element lives together, In order for Si content ratio in this sludge to increase, and for the amount of dissolution of Si to decrease and to promote a deposit of an aluminum-Mn-Si system sludge, it has the operation which controls the fall of the solidus temperature of an aluminum alloy, and has an effect which controls local melting. however, the following of said effect is [each content of V, Zr, and Cr] insufficient 0.01%, on the other hand, each content of V, and Zr and Cr is a hot-working process in a manufacturing process of an Al alloy sheet raw material in ** 0.25%, and hot-working nature falls. Therefore, each content of V, and Zr and Cr should carry out 0.01 to 0.25% of within the limits.
[0023](4) Fe, Ti:Fe, and Ti have the operation which carries out minuteness making of the aluminum-Mn-Si system sludge, and have the effect of raising the intensity after soldering. however, the following of the effect is [the content of Fe / the content of less than 0.2% and Ti] insufficient 0.02%, on the other hand, the content of more than

1.5% and Ti of the content of Fe is a hot-working process in a manufacturing process of an Al alloy sheet raw material in ** 0.25%, and hot-working nature falls. Therefore, the content of Fe should carry out content of Ti 0.02 to 0.25% of within the limits 0.2 to 1.5%.

[0024](5) Mg:Mg has the effect of raising the intensity after soldering. However, the following of the effect of the improving strength after soldering is [the content] insufficient 0.05%, on the other hand, at more than 0.3%, solidus temperature turns into below soldering temperature, and local melting is caused. Therefore, the content of Mg should carry out 0.05 to 0.3% of within the limits.

[0025](6) Each of Zn, Sn and In:Zn, Sn, and In(s) has the operation which makes electrochemical potential of an aluminum alloy **, and gives a sacrificial anode effect. However, as for the content of Zn, the content of In the content of Sn 0.02% less than 0.3% in less than 0.005%. [the following] the effect is insufficient, as for the content of more than 2% and Sn, on the other hand, 0.05%, by **, electrochemical potential becomes ** too much and, as for the content of Zn, a self-corrosion rate becomes large too much, as for the content of more than 0.2% and In. Therefore, as for the content of Zn, the content of Sn should make content of In 0.005 to 0.05% of within the limits 0.02 to 0.2% 0.3 to 2%.

[Translation done.]

EXAMPLE

[Example]Next, this invention is explained according to working example, contrasting with a comparative example. Table 1 No.I-1 which has the chemical composition of this invention shown in 2 within the limits - 43 -- and, [and] Table 3 And prepare the aluminum alloy molten metal of No.C-1 which has the chemical composition besides the range of this invention shown in 4 - 25, from this, cast the slab of a size (width 200 mm, length 400 mm, and 50 mm in thickness), and rank second, After homogenizing in slab, with hot-rolling, it was considered as the 5-mm-thick hot-rolling board, and further, intermediate annealing and cold rolling were repeated and performed, it was considered as the cold-rolled board of thickness 0.1 mm, and the aluminum alloy fin material was manufactured.

[0027]

[Table 1]

	No	化学成分組成 (wt.%)										
		Si	Mn	V	Zr	Cr	Mg	Fe	Ti	Zn	Sn	In
本発明Al合金フィン材	I-1	0.96	1.51	0.13	0.10	0.14	—	—	—	—	—	—
	I-2	1.02	1.81	0.11	0.11	0.13	—	—	—	—	—	—
	I-3	1.13	2.34	0.12	0.13	0.12	—	—	—	—	—	—
	I-4	1.03	2.91	0.11	0.11	0.13	—	—	—	—	—	—
	I-5	0.75	2.35	0.14	0.11	0.13	—	—	—	—	—	—
	I-6	1.49	2.28	0.12	0.12	0.13	—	—	—	—	—	—
	I-7	1.33	2.31	0.02	0.11	0.13	—	—	—	—	—	—
	I-8	1.31	2.25	0.24	0.13	0.12	—	—	—	—	—	—
	I-9	1.14	2.28	0.13	0.02	0.13	—	—	—	—	—	—
	I-10	1.12	2.33	0.11	0.25	0.12	—	—	—	—	—	—
	I-11	1.12	2.36	0.12	0.13	0.03	—	—	—	—	—	—
	I-12	0.81	2.04	0.13	0.13	0.25	—	—	—	—	—	—
	I-13	1.12	2.31	0.10	0.11	0.15	—	0.32	—	—	—	—
	I-14	1.18	2.39	0.11	0.14	0.14	—	0.81	—	—	—	—
	I-15	1.15	2.27	0.13	0.13	0.14	—	1.50	—	—	—	—
	I-16	1.39	2.25	0.14	0.13	0.13	—	—	0.02	—	—	—
	I-17	1.24	2.31	0.16	0.15	0.13	—	—	0.13	—	—	—
	I-18	0.88	2.23	0.15	0.14	0.15	—	—	0.24	—	—	—
	I-19	1.12	2.30	0.15	0.11	0.14	—	0.22	0.24	—	—	—
	I-20	1.26	2.15	0.13	0.13	0.14	—	0.81	0.10	—	—	—
	I-21	1.22	2.20	0.12	0.15	0.15	—	1.44	0.03	—	—	—

[0028]

[Table 2]

	No	化学成分組成 (wt.%)										
		Si	Mn	V	Zr	Cr	Mg	Fe	Ti	Zn	Sn	In
本発明Al合金フィン材	I-22	1.23	2.26	0.16	0.14	0.13	0.05	—	—	—	—	—
	I-23	1.16	2.20	0.13	0.13	0.15	0.28	—	—	—	—	—
	I-24	1.18	2.25	0.14	0.12	0.14	0.05	0.83	—	—	—	—
	I-25	1.21	2.23	0.15	0.14	0.16	0.28	—	0.13	—	—	—
	I-26	1.19	2.26	0.14	0.15	0.15	0.05	0.83	0.15	—	—	—
	I-27	1.24	2.18	0.14	0.13	0.13	0.30	0.79	0.13	—	—	—
	I-28	1.21	2.22	0.14	0.15	0.14	—	—	—	1.24	—	—
	I-29	1.22	2.21	0.15	0.13	0.14	—	—	—	—	0.10	—
	I-30	1.22	2.23	0.13	0.14	0.15	—	—	—	—	—	0.025
	I-31	1.26	2.06	0.12	0.14	0.15	—	—	—	1.89	0.19	0.047
	I-32	1.22	2.20	0.13	0.16	0.13	—	0.80	—	1.28	—	—
	I-33	1.25	2.24	0.15	0.14	0.13	—	—	0.15	—	0.12	—
	I-34	1.21	2.20	0.14	0.14	0.15	—	0.55	0.13	—	—	0.023
	I-35	1.21	2.13	0.13	0.12	0.15	—	0.22	0.14	1.99	0.20	0.049
	I-36	1.19	2.15	0.15	0.13	0.15	0.20	—	—	1.26	—	—
	I-37	1.21	2.23	0.13	0.15	0.16	0.19	—	—	—	0.14	—
	I-38	1.24	2.20	0.14	0.12	0.13	0.23	—	—	—	—	0.025
	I-39	1.18	2.19	0.15	0.14	0.14	0.21	—	—	1.86	0.19	0.045
	I-40	1.18	2.22	0.13	0.16	0.13	0.20	0.81	0.14	1.23	—	—
	I-41	1.23	2.19	0.15	0.13	0.14	0.21	0.78	0.15	—	0.15	—
	I-42	1.21	2.23	0.14	0.14	0.16	0.19	0.81	0.12	—	—	0.022
	I-43	1.46	2.94	0.20	0.23	0.22	0.28	1.48	0.24	1.93	0.20	0.042

[0029]

[Table 3]

	No	化学成分組成 (wt.%)											
		Si	Mn	V	Zr	Cr	Mg	Fe	Ti	Zn	Sn	In	Cu
比較Al合金フィン材	C-1	0.95	1.41	0.14	0.10	0.12	—	—	—	—	—	—	—
	C-2	1.01	3.14	0.11	0.13	0.10	—	—	—	—	—	—	—
	C-3	0.63	2.30	0.13	0.10	0.15	—	—	—	—	—	—	—
	C-4	1.64	2.19	0.13	0.12	0.16	—	—	—	—	—	—	—
	C-5	1.28	2.33	0.006	0.11	0.13	—	—	—	—	—	—	—
	C-6	1.17	2.15	0.27	0.13	0.15	—	—	—	—	—	—	—
	C-7	1.13	2.36	0.13	0.007	0.14	—	—	—	—	—	—	—
	C-8	1.12	2.38	0.12	0.26	0.11	—	—	—	—	—	—	—
	C-9	1.18	2.41	0.10	0.13	0.006	—	—	—	—	—	—	—
	C-10	0.82	2.01	0.09	0.15	0.27	—	—	—	—	—	—	—
	C-11	1.14	2.27	0.14	0.11	0.10	—	1.63	—	—	—	—	—
	C-12	0.90	2.18	0.11	0.10	0.11	—	—	0.27	—	—	—	—
	C-13	1.28	1.98	0.13	0.12	0.12	—	0.90	0.28	—	—	—	—
	C-14	1.16	2.20	0.13	0.13	0.15	0.42	—	—	—	—	—	—

[0030]

[Table 4]

	No	化学成分組成 (wt.%)											
		Si	Mn	V	Zr	Cr	Mg	Fe	Ti	Zn	Sn	In	Cu
比	C-15	1.24	2.18	0.14	0.13	0.13	0.38	0.79	0.13	—	—	—	—
較	C-16	1.13	2.34	0.12	0.13	0.12	—	—	—	2.56	—	—	—
Al	C-17	1.13	2.34	0.12	0.13	0.12	—	—	—	—	0.32	—	—
合	C-18	1.13	2.34	0.12	0.13	0.12	—	—	—	—		0.062	—
金	C-19	1.13	2.34	0.12	0.13	0.12	—	—	—	—	0.32	0.061	—
フ	C-20	1.13	2.34	0.12	0.13	0.12	—	—	—	2.30	0.35	0.059	—
ィ	C-21	1.23	2.13	0.15	0.15	0.13	—	0.83	0.11	2.31	0.33	0.063	—
ン	C-22	1.25	2.20	0.14	0.16	0.14	0.14	—	—	2.28	0.31	0.061	—
材	C-23	1.24	2.18	0.14	0.13	0.13	0.30	0.79	0.13	2.25	0.34	0.056	—
従	C-24	0.88	0.85	—	<0.01	<0.01	0.70	0.25	0.01	—	—	—	0.23
来	C-25	0.63	1.35	—	0.72	0.08	0.53	0.40	0.06	—	—	—	0.21

(注) 従来：従来Al合金フィン材を意味する。

[0031]In order to evaluate the hot-working nature in the manufacturing process of an Al alloy sheet raw material, the existence of the crack generation of the surface of said hot-rolling board was inspected visually.

[0032]The aluminum alloy fin material blank test material of said thickness 0.1 mm is extracted, The vacuum-chamber internal pressure of 0.1 Pa which is the conditions equivalent to vacuum soldering, and temperature 605 **5 After performing processing cooled after maintenance between parts, the predetermined specimen was prepared and a tensile test, measurement of solidus temperature, and measurement of pitting generating potential were presented. The Shimadzu DTA-50 type testing machine was used for measurement of solidus temperature. The measurement result of the various above-mentioned examinations was shown in Table 5, and 6 and 7.

[0033]

[Table 5]

	No	引張強さ (N/mm²)	固相線温度 (℃)	孔食発生電位 (V vs.SCE)	熱延時のクラック発生有無
本発明Al合金フィン材	I-1	191	642	−0.77	無し
	I-2	193	644	−0.77	無し
	I-3	194	650	−0.77	無し
	I-4	196	654	−0.77	無し
	I-5	190	655	−0.77	無し
	I-6	215	646	−0.77	無し
	I-7	194	638	−0.77	無し
	I-8	196	653	−0.77	無し
	I-9	194	638	−0.77	無し
	I-10	196	653	−0.77	無し
	I-11	194	638	−0.77	無し
	I-12	196	653	−0.77	無し
	I-13	205	650	−0.77	無し
	I-14	216	651	−0.77	無し
	I-15	227	651	−0.77	無し
	I-16	201	650	−0.77	無し
	I-17	208	650	−0.77	無し
	I-18	215	651	−0.77	無し
	I-19	220	650	−0.77	無し
	I-20	221	651	−0.77	無し
	I-21	220	651	−0.77	無し

[0034]

[Table 6]

	No	引張強さ (N/mm²)	固相線温度 (℃)	孔食発生電位 (V vs.SCE)	熱延時のクラック発生有無
本発明Al合金フィン材	I-22	206	646	−0.77	無し
	I-23	225	640	−0.77	無し
	I-24	226	647	−0.77	無し
	I-25	236	639	−0.77	無し
	I-26	237	647	−0.77	無し
	I-27	242	638	−0.77	無し
	I-28	194	649	−0.92	無し
	I-29	194	650	−0.93	無し
	I-30	194	650	−0.93	無し
	I-31	194	649	−0.97	無し
	I-32	217	649	−0.93	無し
	I-33	209	649	−0.94	無し
	I-34	215	650	−0.93	無し
	I-35	216	650	−0.98	無し
	I-36	215	642	−0.92	無し
	I-37	214	643	−0.93	無し
	I-38	218	642	−0.92	無し
	I-39	217	641	−0.96	無し
	I-40	243	642	−0.91	無し
	I-41	242	644	−0.93	無し
	I-42	245	643	−0.91	無し
	I-43	251	642	−0.97	無し

[0035]

[Table 7]

	No	引張強さ (N/mm²)	固相線温度 (℃)	孔食発生電位 (V vs.SCE)	熱交時のクラック発生有無
比較Al合金フィン材	C-1	190	615*	−0.77	無し
	C-2	198	657	−0.77	有り*
	C-3	164*	656	−0.77	無し
	C-4	219	614*	−0.77	無し
	C-5	194	617*	−0.77	無し
	C-6	196	654	−0.77	有り*
	C-7	194	617*	−0.77	無し
	C-8	196	654	−0.77	有り*
	C-9	194	617*	−0.77	無し
	C-10	196	654	−0.77	有り*
	C-11	230	651	−0.77	有り*
	C-12	217	651	−0.77	有り*
	C-13	226	651	−0.77	有り*
	C-14	228	617*	−0.77	無し
	C-15	245	618*	−0.77	無し
	C-16	194	649	−1.22*	無し
	C-17	194	650	−1.29*	無し
	C-18	194	650	−1.27*	無し
	C-19	194	650	−1.39*	無し
	C-20	194	650	−1.44*	無し
	C-21	238	649	−1.45*	無し
	C-22	221	649	−1.45*	無し
	C-23	242	649	−1.45*	無し
従来	C-24	244	606*	−0.74	無し
	C-25	211	612*	−0.74	有り*

(注) 従来は、従来Al合金フィン材を意味する。また、*印をつけたものは、特性値が劣るものである。

[0036]Table 1 The following matter is clear from −7.

** Although the thing of insufficient strength occurred like the No. C−3 in the comparison aluminum alloy fin material about tensile strength, even if there is nothing of such insufficient strength in this invention aluminum alloy fin material and it compared with the aluminum alloy fin material conventionally, the equivalent outstanding intensity was obtained.

[0037]** About solidus temperature, No.C−1 of a comparison aluminum alloy fin material, 4, 5, 7, 9 and 14, and 15 were 614 − 618 **, and were low, it was low conventionally to the same extent as an aluminum alloy fin material, and improvement in soldering nature was not carried out. On the other hand, each this invention aluminum alloy fin material is 638−655 ** and high temperature, and its soldering nature improved remarkably.

[0038]** No.C−16 of a comparison aluminum alloy fin material − 23 are −1.45 −

$-1.22V_{vs}$S C E to being potential with -1.10 - $-0.60V_{vs}$S C E desirable about pitting generating potential.
Electrochemical potential becomes ** too much in each case, and the self-corrosion rate became large too much.
On the other hand, all the pitting corrosion potential of this invention aluminum alloy fin material is -0.98 - $-0.77V_{vs}$S C E, and the desirable sacrificial anode effect was acquired.
** Although it generated in No.C-2 of a comparison aluminum alloy fin material, 6 and 8, and 10-13 about the crack at the time of hot-rolling, it did not generate in this invention aluminum alloy fin material.
[0039]As mentioned above, this invention aluminum alloy fin material improves about soldering nature conventionally more remarkably than an aluminum alloy fin material and a comparison aluminum alloy fin material, and is excellent conventionally to the same extent as an aluminum alloy fin material about the intensity after soldering. About a sacrificial anode effect, it is equivalent to a former and comparison aluminum alloy fin material, and, moreover, excelled a former and comparison aluminum alloy fin material and more than equivalent also about the hot-working nature of the aluminum alloy in the manufacturing process of a fin material.

[Translation done.]

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(54)【発明の名称】　ろう付け後強度およびろう付け性に優れたＡｌ合金フィン材

(57)【要約】
【目的】　ろう付け工法によって製造される自動車用熱交換器等に用いられる、ろう付け後強度およびろう付け性に優れたAl合金フィン材を提供する。
【構成】　第１発明：重量％で、Si：0.7～1.5％、Mn：1.5～3％、V：0.01～0.25％、Zr：0.01～0.25％、および、Cr：0.01～0.25％を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有する。第２発明：重量％で、Si：0.7～1.5％、Mn：1.5～3％、V：0.01～0.25％、Zr：0.01～0.25％、および、Cr：0.01～0.25％を含有し、更に、Fe：0.2～1.5％、および、Ti：0.02～0.25％の内、少なくとも１種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有する。第１発明または第２発明の化学成分組成に、更に、Mg：0.05～0.3％を含有するもの。上記すべての発明に、更に、Zn：0.3～2％、Sn：0.02～0.2％、および、In：0.005～0.05％の内、少なくとも１種を含有するもの。

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【特許請求の範囲】

【請求項１】　重量% で、
シリコン(Si)　：0.7 ～1.5%、
マンガン(Mn)　：1.5 ～3　%、
バナジウム(V)　：0.01～0.25% 、
ジルコニウム(Zr)：0.01～0.25% 、および、
クロム(Cr)　　：0.01～0.25% 、
を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することを特徴とする、ろう付け後強度およびろう付け性に優れたAl合金フィン材。

【請求項２】　重量% で、
シリコン(Si)　：0.7 ～1.5%、
マンガン(Mn)　：1.5 ～3　%、
バナジウム(V)　：0.01～0.25% 、
ジルコニウム(Zr)：0.01～0.25% 、および、
クロム(Cr)　　：0.01～0.25% 、
を含有し、更に、
鉄(Fe)　　：0.2 ～1.5%、および、
チタン(Ti)　　：0.02～0.25% 、
の内、少なくとも１種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することを特徴とする、ろう付け後強度およびろう付け性に優れたAl合金フィン材。

【請求項３】　重量% で、
シリコン(Si)　：0.7 ～1.5%、
マンガン(Mn)　：1.5 ～3　%、
バナジウム(V)　：0.01～0.25% 、
ジルコニウム(Zr)：0.01～0.25% 、
クロム(Cr)　　：0.01～0.25% 、および、
マグネシウム(Mg)：0.05～0.3%、
を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することを特徴とする、ろう付け後強度およびろう付け性に優れたAl合金フィン材。

【請求項４】　重量% で、
シリコン(Si)　：0.7 ～1.5%、
マンガン(Mn)　：1.5 ～3　%、
バナジウム(V)　：0.01～0.25% 、
ジルコニウム(Zr)：0.01～0.25% 、
クロム(Cr)　　：0.01～0.25% 、および、
マグネシウム(Mg)：0.05～0.3%、
を含有し、更に、
鉄(Fe)　　：0.2 ～1.5%、および、
チタン(Ti)　　：0.02～0.25% 、
の内、少なくとも１種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することを特徴とする、ろう付け後強度およびろう付け性に優れたAl合金フィン材。

【請求項５】　重量% で、
シリコン(Si)　：0.7 ～1.5%、
マンガン(Mn)　：1.5 ～3　%、

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バナジウム(V)　：0.01～0.25% 、
ジルコニウム(Zr)：0.01～0.25% 、および、
クロム(Cr)　　：0.01～0.25% 、
を含有し、更に、
亜鉛(Zn)　　：0.3 ～2%、
錫(Sn)　　：0.02～0.2%、および、
インジウム(In)　：0.005 ～0.05% 、
の内、少なくとも1 種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することを特徴とする、ろう付け後強度およびろう付け性に優れたAl合金フィン材。

【請求項６】　重量% で、
シリコン(Si)　：0.7 ～1.5%、
マンガン(Mn)　：1.5 ～3　%、
バナジウム(V)　：0.01～0.25% 、
ジルコニウム(Zr)：0.01～0.25% 、および、
クロム(Cr)　　：0.01～0.25% 、
を含有し、更に、
鉄(Fe)　　：0.2 ～1.5%、および、
チタン(Ti)　　：0.02～0.25% 、
の内、少なくとも1 種、および、
亜鉛(Zn)　　：0.3 ～2%、
錫(Sn)　　：0.02～0.2%、および、
インジウム(In)　：0.005 ～0.05% 、
の内、少なくとも1 種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することを特徴とする、ろう付け後強度およびろう付け性に優れたAl合金フィン材。

【請求項７】　重量% で、
シリコン(Si)　：0.7 ～1.5%、
マンガン(Mn)　：1.5 ～3　%、
バナジウム(V)　：0.01～0.25% 、
ジルコニウム(Zr)：0.01～0.25% 、
クロム(Cr)　　：0.01～0.25% 、および、
マグネシウム(Mg)：0.05～0.3%、
を含有し、更に、
亜鉛(Zn)　　：0.3 ～2%、
錫(Sn)　　：0.02～0.2%、および、
インジウム(In)　：0.005 ～0.05% 、
の内、少なくとも1 種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することを特徴とする、ろう付け後強度およびろう付け性に優れたAl合金フィン材。

【請求項８】　重量% で、
シリコン(Si)　：0.7 ～1.5%、
マンガン(Mn)　：1.5 ～3　%、
バナジウム(V)　：0.01～0.25% 、
ジルコニウム(Zr)：0.01～0.25% 、
クロム(Cr)　　：0.01～0.25% 、および、
マグネシウム(Mg)：0.05～0.3%、

を含有し、更に、
鉄(Fe)　　：0.2 ～1.5%、および、
チタン(Ti)　　：0.02～0.25% 、
の内、少なくとも1 種、および、
亜鉛(Zn)　　：0.3 ～2%、
錫(Sn)　　：0.02～0.2%、および、
インジウム(In)　：0.005 ～0.05% 、
の内、少なくとも1 種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することを特徴とする、ろう付け後強度およびろう付け性に優れたAl合金フィン材。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、ろう付け工法によって製造される自動車用熱交換器等に用いられるフィン材に関するものである。

【０００２】

【従来の技術】Al合金は軽くて熱伝導性に優れ、且つ、耐食性が良好であることから、自動車のラジエータ等の熱交換器の製造に広く用いられている。アルミニウム合金熱交換器は、例えば、Al－Mn系合金等からなる作動流体通路材料（以下、管材という）に、これよりも電気化学的に卑なアルミニウム合金のフィン材が、ろう付けにより組み立てられている。そして、電気化学的に卑なフィン材の犠牲陽極効果によって作動流体通路材料が防食されている。

【０００３】ろう付けは、管材とフィン材との組合せ体をろう付け温度に、真空中で加熱するか、または、不活性雰囲気中もしくは大気中でフラックスを用いて加熱することによって行う。管材およびフィン材の少なくとも一方には、Al－Si系またはAl－Si－Mg系等のろう材をクラッドしたブレージングシートが用いられており、フィン材は、ろう付け時の高温加熱によって強度が著しく低下して変形したり、ろう材中のSi原子がフィン材中に拡散して座屈したりする。このようなフィン材の著しい変形および座屈は、ろう付け加熱時の材料の局部溶融によって発生する（以下、このような変形および座屈を生じない性質をろう付け性という）。

【０００４】アルミニウム合金熱交換器用のフィン材は、ろう付け後の熱交換器使用時の風圧等に対して変形しない十分な強度を必要とする。さらに、フィン素材製造時の熱間加工性が優れていることが重要である。

【０００５】そこで、上述したようなアルミニウム合金熱交換器のフィン材の特性を改善するために、1%程度のMnを含有するAl－Mn系合金に、ろう付け後の強度を向上させるために1%程度のSiを含有させたAl－Mn－Si系合金に、更に、種々の元素を含有させた下記の技術が提案されている。熱交換器Al合金製フィン材のろう付け後の強度、および、ろう付性の改善に関する技術として、例えば、特開昭58-156197号公報(以下、先行技術1 という）、特開昭63-213646 号公報(以下、先行技術2 という）、および、特開平3-13550 号公報(以下、先行技術3 という）がある。

【０００６】先行技術1 は、フィンに用いるA3004 合金に関し、ろう付け中に、Al- Si合金ろう材中のSiがフィン材内部へ過拡散して局部溶融するためろう付け継手の幅が著しく減少したり、継手の強度が低下するのを防止し、超高圧用プレートフィン型熱交換器を提供することを目的とし、Cuを0.05～0.25% 含有させたAl合金を開示している。

【０００７】先行技術2 は、フィン材と管材を真空ろう付けした場合、フィン材中のZnの蒸発による管材に対する犠牲陽極効果の低下を防止すること、および、高温強度(耐垂下性）およびろう付け後の強度を確保するために、Snを0.03～0.15% 含有したAl合金製皮材を、Al合金製芯材の両面にクラッドした複合材を開示している。

【０００８】先行技術3 は、耐高温座屈性と、フィン材を薄肉化した場合、強度不足のためフィンをコルゲート加工して管材を組付ける時にフィンが潰れる、所謂、常温座屈の発生を防止するための高い強度とを兼備したフィン材の製造を目的として、最終Cr、Zr、TiおよびV を含有させ、且つ、最終冷間圧延前の焼鈍を240 ～300℃未満という、冷間圧延前に行われる通常の焼鈍温度(300～450 ℃）より低温度で行う技術を開示している。

【０００９】

【発明が解決しようとする課題】しかしながら、先行技術１～３ではいずれも、ろう付け後の強度を向上させるために含有させたSiがその効果を発揮するが、一方、ろう付け条件に依存してその条件によっては、フィン材をろう付け温度に加熱すると、フィン材中に固溶しているSiの作用で材料の固相線温度が低下し、局部溶融を引き起こすことがある。このように、先行技術１～３では、ろう付性に問題があり、特に、このような現象はAl合金フィン材の板厚が薄い場合に顕著となるため、最近高まりつつあるフィン材の薄肉化に対する要求に十分応えられない状態にある。

【００１０】従って、この発明の目的は、上述した問題点を解決し、ろう付け工法によって製造される自動車用熱交換器等に用いられる、ろう付け後強度およびろう付け性に優れたAl合金フィン材を提供することにある。

【００１１】

【課題を解決するための手段】ろう付け後強度およびろう付け性に優れたAl合金フィン材について、本発明者等は鋭意研究を重ねた結果、次の知見を得た。即ち、Al－Mn－Si系のAl合金中のMnには、SiがAl－Mn－Si系析出物として析出するのを促進する作用があり、Siの固溶量を抑制するので、Siの固溶によるAl合金の固相線温度の低下を防ぐ効果があること、および、V 、Zr、およびCrの３元素が共存すると、これら３元素がAl－Mn－Si系析出物に取り込まれ、この析出物中のSi含有比率が増加し、

Siの固溶量が減少するため、Al合金の固相線温度の低下が抑制される。

【００１２】本発明は、上記知見に基づいてなされたものであり、この発明の目的を達成するために、Mnの含有量を増加させたこと、および、V 、ZrおよびCrの3 元素を共存させることを同時に満たすことに顕著な特徴を有するものである。即ち、第１発明のAl合金フィン材は、重量% で、Si：0.7 ～1.5%、Mn：1.5 ～3%、V ：0.01～0.25% 、Zr：0.01～0.25% 、および、Cr：0.01～0.25% を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することに特徴を有するものである。

【００１３】第２発明のAl合金フィン材は、重量% で、Si：0.7 ～1.5%、Mn：1.5 ～3%、V：0.01～0.25% 、Zr：0.01～0.25% 、および、Cr：0.01～0.25% を含有し、更に、Fe：0.2 ～1.5%、および、Ti：0.02～0.25% の内、少なくとも1 種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することに特徴を有するものである。

【００１４】第３発明のAl合金フィン材は、重量% で、Si：0.7 ～1.5%、Mn：1.5 ～3%、V：0.01～0.25% 、Zr：0.01～0.25% 、Cr：0.01～0.25% 、およびMg：0.05～0.3%を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することに特徴を有するものである。

【００１５】第４発明のAl合金フィン材は、重量% で、Si：0.7 ～1.5%、Mn：1.5 ～3%、V：0.01～0.25% 、Zr：0.01～0.25% 、Cr：0.01～0.25% 、およびMg：0.05～0.3%を含有し、更に、Fe：0.2 ～1.5%、および、Ti：0.02～0.25% の内、少なくとも1 種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することに特徴を有するものである。

【００１６】第５発明のAl合金フィン材は、重量% で、Si：0.7 ～1.5%、Mn：1.5 ～3%、V：0.01～0.25% 、Zr：0.01～0.25% 、および、Cr：0.01～0.25% を含有し、更に、Zn：0.3 ～2%、Sn：0.02～0.2%、および、In：0.005 ～0.05% の内、少なくとも1 種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することに特徴を有するものである。

【００１７】第６発明のAl合金フィン材は、重量% で、Si：0.7 ～1.5%、Mn：1.5 ～3%、V：0.01～0.25% 、Zr：0.01～0.25% 、および、Cr：0.01～0.25% を含有し、更に、Fe：0.2 ～1.5%、および、Ti：0.02～0.25% の内、少なくとも1 種、および、Zn：0.3 ～2%、Sn：0.02～0.2%、および、In：0.005 ～0.05% の内、少なくとも1 種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することに特徴を有するものである。

【００１８】第７発明のAl合金フィン材は、重量% で、Si：0.7 ～1.5%、Mn：1.5 ～3%、V：0.01～0.25% 、Zr：0.01～0.25% 、Cr：0.01～0.25% 、およびMg：0.05～0.3%を含有し、更に、Zn：0.3 ～2%、Sn：0.02～0.2%、および、In：0.005 ～0.05%の内、少なくとも1 種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することに特徴を有するものである。

【００１９】第８発明のAl合金フィン材は、重量% で、Si：0.7 ～1.5%、Mn：1.5 ～3%、V：0.01～0.25% 、Zr：0.01～0.25% 、Cr：0.01～0.25% 、およびMg：0.05～0.3%を含有し、更に、Fe：0.2 ～1.5%、および、Ti：0.02～0.25% の内、少なくとも1 種、および、Zn：0.3 ～2%、Sn：0.02～0.2%、および、In：0.005 ～0.05% の内、少なくとも1 種を含有し、残りが、Alおよび不可避不純物からなる化学成分組成を有することに特徴を有するものである。

【００２０】

【作用】この発明のAl合金フィン材の化学成分組成を上述した範囲内に限定した理由について述べる。

(1) Si:Siは、Al合金中に固溶し、あるいは、Al－Mn－Si系化合物として析出して、ろう付け後の強度を向上させる作用を有する。しかしながら、その含有量が0.7%未満ではその効果が不十分であり、一方、1.5%超では固溶量が過多となり固相線温度がろう付け温度以下になって局部溶融を引き起こす。従って、Siの含有量は、0.7 ～1.5%の範囲内とすべきである。

【００２１】(2) Mn:Mnの含有量は従来技術と比較して高く、本発明における最も特徴的な元素である。Mnは、SiがAl－Mn－Si系化合物として析出するのを促進する作用を有し、Siの固溶量を抑制するので、Siの固溶によるAl合金の固相線温度の低下を防ぎ、局部溶融を防止する効果を有する。しかしながら、その含有量が1.5%未満ではその効果が不十分であり、一方、3%超ではAl合金板素材の製造工程中熱間加工工程で、熱間加工性が低下する。従って、Mnの含有量は、1.5 ～3%の範囲内とすべきである。

【００２２】(3) V 、ZrおよびCr:本発明においては、V 、ZrおよびCrの3 元素を共存させた化学成分組成にすることが、従来技術の技術思想と比較して特徴的なものである。V 、Zr、およびCrは、これら３元素が共存すると、これら３元素がAl－Mn－Si系析出物に取り込まれ、この析出物中のSi含有比率が増加し、Siの固溶量が減少し、また、Al－Mn－Si系析出物の析出を促進するため、Al合金の固相線温度の低下を抑制する作用を有し、局部溶融を抑制する効果を有する。しかしながら、V、ZrおよびCrの含有量はいずれも0.01% 未満では前記効果が不十分であり、一方、V 、ZrおよびCrの含有量はいずれも0.25% 超では、Al合金板素材の製造工程中熱間加工工程で、熱間加工性が低下する。従って、V 、ZrおよびCrの含有量はいずれも、0.01～0.25% の範囲内とすべきである。

【００２３】(4) FeおよびTi:FeおよびTiは、Al－Mn－Si系析出物を微細化する作用を有し、ろう付け後の強度

を向上させる効果を有する。しかしながら、Feの含有量は0.2%未満、Tiの含有量は0.02% 未満ではその効果が不十分であり、一方、Feの含有量は1.5%超、Tiの含有量は0.25% 超では、Al合金板素材の製造工程中熱間加工工程で、熱間加工性が低下する。従って、Feの含有量は0.2～1.5%、Tiの含有量は0.02～0.25% の範囲内とすべきである。

【００２４】(5) Mg:Mgは、ろう付け後の強度を向上させる効果を有する。しかしながら、その含有量が、0.05% 未満ではろう付け後の強度向上の効果が不十分であり、一方、0.3%超では固相線温度がろう付け温度以下になり局部溶融を起こす。従って、Mgの含有量は、0.05～0.3%の範囲内とすべきである。

【００２５】(6) Zn、SnおよびIn:Zn、SnおよびInは、いずれもAl合金の電気化学的電位を卑にする作用を有し、犠牲陽極効果を付与する。しかしながら、Znの含有量は0.3%未満、Snの含有量は0.02% 未満、Inの含有量は0.005%未満では、その効果が不十分であり、一方、Znの＊含有量は2%超、Snの含有量は0.2%超、Inの含有量は0.05% 超では、電気化学的電位が卑になり過ぎ、自己腐食速度が大きくなり過ぎる。従って、Znの含有量は0.3 ～2%、Snの含有量は0.02～0.2%、Inの含有量は0.005 ～0.05% の範囲内にすべきである。

【００２６】

【実施例】次に、この発明を実施例により、比較例と対比しながら説明する。表1 および2 に示した本発明の範囲内の化学成分組成を有するNo.I-1～43、および、表3 および4 に示した本発明の範囲外の化学成分組成を有するNo.C-1～25のAl合金溶湯を調製し、これより幅200 mm、長さ400 mm、厚さ50mmの寸法のスラブを鋳造し、次いで、スラブに均質化処理を施した後、熱間圧延によって厚さ5mmの熱延板とし、更に、中間焼鈍および冷間圧延を繰り返し施し、厚さ0.1 mmの冷延板とし、Al合金フィン材を製造した。

【００２７】

【表１】

	No	化学成分組成 (wt.%)										
		Si	Mn	V	Zr	Cr	Mg	Fe	Ti	Zn	Sn	In
本発明Al合金フィン材	I-1	0.96	1.51	0.13	0.10	0.14	—	—	—	—	—	—
	I-2	1.02	1.81	0.11	0.11	0.13	—	—	—	—	—	—
	I-3	1.13	2.34	0.12	0.13	0.12	—	—	—	—	—	—
	I-4	1.03	2.91	0.11	0.11	0.13	—	—	—	—	—	—
	I-5	0.75	2.35	0.14	0.11	0.13	—	—	—	—	—	—
	I-6	1.49	2.28	0.12	0.12	0.13	—	—	—	—	—	—
	I-7	1.33	2.31	0.02	0.11	0.13	—	—	—	—	—	—
	I-8	1.31	2.25	0.24	0.13	0.12	—	—	—	—	—	—
	I-9	1.14	2.28	0.13	0.02	0.13	—	—	—	—	—	—
	I-10	1.12	2.33	0.11	0.25	0.12	—	—	—	—	—	—
	I-11	1.12	2.36	0.12	0.13	0.03	—	—	—	—	—	—
	I-12	0.81	2.04	0.13	0.13	0.25	—	—	—	—	—	—
	I-13	1.12	2.31	0.10	0.11	0.15	—	0.32	—	—	—	—
	I-14	1.18	2.39	0.11	0.14	0.14	—	0.81	—	—	—	—
	I-15	1.15	2.27	0.13	0.13	0.14	—	1.50	—	—	—	—
	I-16	1.39	2.25	0.14	0.13	0.13	—	—	0.02	—	—	—
	I-17	1.24	2.31	0.16	0.15	0.13	—	—	0.13	—	—	—
	I-18	0.88	2.23	0.15	0.14	0.15	—	—	0.24	—	—	—
	I-19	1.12	2.30	0.15	0.11	0.14	—	0.22	0.24	—	—	—
	I-20	1.26	2.15	0.13	0.13	0.14	—	0.81	0.10	—	—	—
	I-21	1.22	2.20	0.12	0.15	0.15	—	1.44	0.03	—	—	—

【００２８】

【表２】

9　　10

	No	化学成分組成 (wt.%)										
		Si	Mn	V	Zr	Cr	Mg	Fe	Ti	Zn	Sn	In
本発明Al合金フィン材	I-22	1.23	2.26	0.16	0.14	0.13	0.05	—	—	—	—	—
	I-23	1.16	2.20	0.13	0.13	0.15	0.28	—	—	—	—	—
	I-24	1.18	2.25	0.14	0.12	0.14	0.05	0.83	—	—	—	—
	I-25	1.21	2.23	0.15	0.14	0.16	0.28	—	0.13	—	—	—
	I-26	1.19	2.26	0.14	0.15	0.15	0.05	0.83	0.15	—	—	—
	I-27	1.24	2.18	0.14	0.13	0.13	0.30	0.79	0.13	—	—	—
	I-28	1.21	2.22	0.14	0.15	0.14	—	—	—	1.24	—	—
	I-29	1.22	2.21	0.15	0.13	0.14	—	—	—	—	0.10	—
	I-30	1.22	2.23	0.13	0.14	0.15	—	—	—	—	—	0.025
	I-31	1.26	2.06	0.12	0.14	0.15	—	—	—	1.89	0.19	0.047
	I-32	1.22	2.20	0.13	0.16	0.13	—	0.80	—	1.28	—	—
	I-33	1.25	2.24	0.15	0.14	0.13	—	—	0.15	—	0.12	—
	I-34	1.21	2.20	0.14	0.14	0.15	—	0.55	0.13	—	—	0.023
	I-35	1.21	2.13	0.13	0.12	0.15	—	0.22	0.14	1.99	0.20	0.049
	I-36	1.19	2.15	0.15	0.13	0.15	0.20	—	—	1.26	—	—
	I-37	1.21	2.23	0.13	0.15	0.16	0.19	—	—	—	0.14	—
	I-38	1.24	2.20	0.14	0.12	0.13	0.23	—	—	—	—	0.025
	I-39	1.18	2.19	0.15	0.14	0.14	0.21	—	—	1.86	0.19	0.045
	I-40	1.18	2.22	0.13	0.16	0.13	0.20	0.81	0.14	1.23	—	—
	I-41	1.23	2.19	0.15	0.13	0.14	0.21	0.78	0.15	—	0.15	—
	I-42	1.21	2.23	0.14	0.14	0.16	0.19	0.81	0.12	—	—	0.022
	I-43	1.46	2.94	0.20	0.23	0.22	0.28	1.48	0.24	1.93	0.20	0.042

【００２９】　　＊　＊【表３】

	No	化学成分組成 (wt.%)											
		Si	Mn	V	Zr	Cr	Mg	Fe	Ti	Zn	Sn	In	Cu
比較Al合金フィン材	C-1	0.95	1.41	0.14	0.10	0.12	—	—	—	—	—	—	—
	C-2	1.01	3.14	0.11	0.13	0.10	—	—	—	—	—	—	—
	C-3	0.63	2.30	0.13	0.10	0.15	—	—	—	—	—	—	—
	C-4	1.64	2.19	0.13	0.12	0.16	—	—	—	—	—	—	—
	C-5	1.28	2.33	0.006	0.11	0.13	—	—	—	—	—	—	—
	C-6	1.17	2.15	0.27	0.13	0.15	—	—	—	—	—	—	—
	C-7	1.13	2.36	0.13	0.007	0.14	—	—	—	—	—	—	—
	C-8	1.12	2.38	0.12	0.26	0.11	—	—	—	—	—	—	—
	C-9	1.18	2.41	0.10	0.13	0.006	—	—	—	—	—	—	—
	C-10	0.82	2.01	0.09	0.15	0.27	—	—	—	—	—	—	—
	C-11	1.14	2.27	0.14	0.11	0.10	—	1.63	—	—	—	—	—
	C-12	0.90	2.18	0.11	0.10	0.11	—	—	0.27	—	—	—	—
	C-13	1.28	1.98	0.13	0.12	0.12	—	0.90	0.28	—	—	—	—
	C-14	1.16	2.20	0.13	0.13	0.15	0.42	—	—	—	—	—	—

【００３０】　　【表４】

	No	化学成分組成 (wt.%)											
		Si	Mn	V	Zr	Cr	Mg	Fe	Ti	Zn	Sn	In	Cu
比較Al合金フィン材	C-15	1.24	2.18	0.14	0.13	0.13	0.38	0.79	0.13	—	—	—	—
	C-16	1.13	2.34	0.12	0.13	0.12	—	—	—	2.56	—	—	—
	C-17	1.13	2.34	0.12	0.13	0.12	—	—	—	—	0.32	—	—
	C-18	1.13	2.34	0.12	0.13	0.12	—	—	—	—		0.062	—
	C-19	1.13	2.34	0.12	0.13	0.12	—	—	—	—	0.32	0.061	—
	C-20	1.13	2.34	0.12	0.13	0.12	—	—	—	2.30	0.35	0.059	—
	C-21	1.23	2.13	0.15	0.15	0.13	—	0.83	0.11	2.31	0.33	0.063	—
	C-22	1.25	2.20	0.14	0.16	0.14	0.14	—	—	2.28	0.31	0.061	—
	C-23	1.24	2.18	0.14	0.13	0.13	0.30	0.79	0.13	2.25	0.34	0.056	—
従来	C-24	0.88	0.85	—	<0.01	<0.01	0.70	0.25	0.01	—	—	—	0.23
	C-25	0.63	1.35	—	0.72	0.08	0.53	0.40	0.06	—	—	—	0.21

(注) 従来：従来Al合金フィン材を意味する。

【００３１】Al合金板素材の製造工程における熱間加工性を評価するために、前記熱延板の表面のクラック発生の有無を目視で検査した。

【００３２】更に、前記厚さ0.1 mmのAl合金フィン材から試験材を採取し、真空ろう付けに相当する条件である、真空槽内圧力0.1Pa 、温度605 ℃で5 分間保持後冷却する処理を施した後、所定の試験片を調製し、引張試＊験、固相線温度の測定および孔食発生電位の測定に供した。固相線温度の測定には、島津製作所製DTA-50型試験機を使用した。上記各種試験の測定結果を、表5 、6 および7 に示した。

【００３３】

【表５】

	No	引張強さ (N/mm²)	固相線温度 (℃)	孔食発生電位 (V vs.SCE)	熱延時のクラック発生有無
本発明Al合金フィン材	I-1	191	642	−0.77	無し
	I-2	193	644	−0.77	無し
	I-3	194	650	−0.77	無し
	I-4	196	654	−0.77	無し
	I-5	190	655	−0.77	無し
	I-6	215	646	−0.77	無し
	I-7	194	638	−0.77	無し
	I-8	196	653	−0.77	無し
	I-9	194	638	−0.77	無し
	I-10	196	653	−0.77	無し
	I-11	194	638	−0.77	無し
	I-12	196	653	−0.77	無し
	I-13	205	650	−0.77	無し
	I-14	216	651	−0.77	無し
	I-15	227	651	−0.77	無し
	I-16	201	650	−0.77	無し
	I-17	208	650	−0.77	無し
	I-18	215	651	−0.77	無し
	I-19	220	650	−0.77	無し
	I-20	221	651	−0.77	無し
	I-21	220	651	−0.77	無し

【００３４】　　40　【表６】

	No	引張強さ (N/mm²)	固相線温度 (℃)	孔食発生電位 (V vs.SCE)	熱延時のクラック発生有無
本発明Al合金フィン材	I-22	206	646	−0.77	無し
	I-23	225	640	−0.77	無し
	I-24	226	647	−0.77	無し
	I-25	236	639	−0.77	無し
	I-26	237	647	−0.77	無し
	I-27	242	638	−0.77	無し
	I-28	194	649	−0.92	無し
	I-29	194	650	−0.93	無し
	I-30	194	650	−0.93	無し
	I-31	194	649	−0.97	無し
	I-32	217	649	−0.93	無し
	I-33	209	649	−0.94	無し
	I-34	215	650	−0.93	無し
	I-35	216	650	−0.98	無し
	I-36	215	642	−0.92	無し
	I-37	214	643	−0.93	無し
	I-38	218	642	−0.92	無し
	I-39	217	641	−0.96	無し
	I-40	243	642	−0.91	無し
	I-41	242	644	−0.93	無し
	I-42	245	643	−0.91	無し
	I-43	251	642	−0.97	無し

【００３５】

＊　＊【表７】

	No	引張強さ (N/mm²)	固相線温度 (℃)	孔食発生電位 (V vs.SCE)	熱延時のクラック発生有無
比較Al合金フィン材	C-1	190	615＊	−0.77	無し
	C-2	198	657	−0.77	有り＊
	C-3	164＊	656	−0.77	無し
	C-4	219	614＊	−0.77	無し
	C-5	194	617＊	−0.77	無し
	C-6	196	654	−0.77	有り＊
	C-7	194	617＊	−0.77	無し
	C-8	196	654	−0.77	有り＊
	C-9	194	617＊	−0.77	無し
	C-10	196	654	−0.77	有り＊
	C-11	230	651	−0.77	有り＊
	C-12	217	651	−0.77	有り＊
	C-13	226	651	−0.77	有り＊
	C-14	228	617＊	−0.77	無し
	C-15	245	618＊	−0.77	無し
	C-16	194	649	−1.22＊	無し
	C-17	194	650	−1.29＊	無し
	C-18	194	650	−1.27＊	無し
	C-19	194	650	−1.39＊	無し
	C-20	194	650	−1.44＊	無し
	C-21	238	649	−1.45＊	無し
	C-22	221	649	−1.45＊	無し
	C-23	242	649	−1.45＊	無し
従来	C-24	244	606＊	−0.74	無し
	C-25	211	612＊	−0.74	有り＊

㈱注）　従来は、従来Al合金フィン材を意味する。また、＊印をつけたものは、特性値が劣るものである。

【００３６】表1 ～7 から、下記事項が明らかである。①引張強さについて、比較Al合金フィン材の中には、そのNo. C-3 のように、強度不足のものが発生したが、本発明Al合金フィン材には、そのような強度不足のものはなく、また、従来Al合金フィン材と比較しても同等の優れた強度が得られた。

【００３７】②固相線温度について、比較Al合金フィン材のNo.C-1,4,5,7,9,14 および15は614 ～618 ℃であって低く、従来Al合金フィン材と同程度に低く、ろう付け性の向上はしなかった。これに対して、本発明Al合金フ

ィン材はいずれも638 ～655℃と高温度であって、ろう付け性が著しく向上した。

【００３８】❸孔食発生電位について、－1.10～－0.60 V vs SCE が望ましい電位であるのに対して、比較Al合金フィン材のNo.C-16 ～23は、－1.45～－1.22V vs SCE であり、いずれも電気化学的電位が卑になり過ぎ、自己腐食速度が大きくなり過ぎた。これに対して、本発明Al合金フィン材の孔食腐食電位はすべて－0.98～－0.77Vvs SCE であり、望ましい犠牲陽極効果が得られた。

❹熱延時のクラックについては、比較Al合金フィン材のNo.C-2,6,8および10～13に発生したが、本発明Al合金フィン材には発生しなかった。

【００３９】上述したように、本発明Al合金フィン材は、ろう付け性については、従来Al合金フィン材および比較Al合金フィン材よりも著しく向上し、ろう付け後の強度については、従来Al合金フィン材と同程度に優れており、犠牲陽極効果については、従来および比較Al合金フィン材と同等であり、しかもフィン材の製造過程におけるAl合金の熱間加工性についても従来および比較Al合金フィン材と同等以上に優れていた。

【００４０】

【発明の効果】以上述べたように、本発明のAl合金フィン材によれば、ろう付け加熱時に局部溶融を起こすことがなく、ろう付け不良の発生がなくなり、ろう付け性に優れ、且つ、ろう付け後の強度についても従来合金フィン材と同等に優れたAl合金フィン材が得られ、Al合金フィン材の薄肉化に対する要求に十分応えることができる、工業上有用な効果がもたらされる。